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Further Experiments with Cotton in Malaya.

W. N. SANDS.

In a previous number (1) of this Journal an account was given of certain experiments that had been made with long and short-staple cottons in Malaya. This work has been continued on a small scale to date with the object of preserving certain varieties and types which have been found to grow and bear well under local conditions, and also to provide the nucleus of a supply of selected seed for distribution should the cultivation of cotton be taken up at some future time in any part of the Peninsula. The results of these investigations are now published in order to place them on record for reference purposes.

A few small trials of selected strains have been made in different places locally, but, as a general rule, the results of these trials have not been encouraging. This was due in several instances to unsuitable soil; lack of knowledge of the crop and of the control of pests, as well as to the difficulty of ginning and marketing small quantities of lint and seed. It is doubtful whether cotton growing would prove as remunerative, in normal years, as the industries that are already established along the West coast of Malaya, but in the Northern and Eastern States, where the seasons are more sharply defined; where large areas are devoted to annual crops, and where the soil and rainfall are suitable, there appears to be no reason why a good class of cotton should not be grown. It would be necessary, however, in starting the industry to obtain expert advice and assistance in organising and prosecuting it in order to obtain the best results in the shortest possible time. Enquiries would also have to be made con-

(1) M. A. J. Vol. X Nos. 10, 11, 12. Oct.—Dec. 1928.

cerning the best markets for the class, or classes, of cotton it was decided to produce, and in this connection the possibilities of India, China and Japan, as well as Great Britain and the United States, would require to be explored.

The experiments conducted by the Botanical Division of the Department of Agriculture have been carried on continuously since the 1921 season, so that some of the varieties and strains have been under observation for the past seven years. In the Kuala Lumpur district, where the cottons were grown as annuals, planting has always been done towards the end of March or the beginning of April in each season. The rainfall of the months of April, May and June was usually ample for vegetative growth, whilst that of July, August and September was sufficiently low to enable the bolls to develop and ripen well.

The following cottons have been grown:

Sea Island	—	6 types.
Egyptian	—	4 „
Upland	—	5 „

together with certain varieties imported from India and elsewhere, or collected locally.

Of the six West Indian types of Sea Island cotton, two only have been retained for further trials in 1929: these are pure strains originally obtained from St. Vincent, West Indies, in 1921, under the marks USSI and AN. Both have made strong and healthy growth and have yielded well each season in small plots. They produce lint of good ordinary grade of this class of long-staple cotton.

Three Egyptian cottons, namely 'Assili' and two strains of 'Sakellaridis' have shown desirable qualities, and these also, are being preserved.

The Upland varieties tried have not grown well, and only the long-staple 'Acala', which was obtained from Nanking, China, appeared to be worth keeping.

None of the other introduced varieties such as Garo Hill, Uppam and Cambodia gave satisfactory returns, and besides, the lint was of low quality and value.

A long-staple cotton grown in Grik in Upper Perak, which resembled the 'Marie Galante' variety of the West Indies, was the best of those collected locally. It had no doubt been imported, originally, from India or Siam.

In the experimental plots the plants were grown singly in light, fertile and well-drained soil, and spaced at distances of 4 feet by 20 inches. In order to prevent cross-pollination by insects, all the flowers produced were closely tied with a piece of worsted before the petals opened. The flowers of the varieties grown, readily pollinated themselves successfully, although they were not allowed to open, so that no difficulty was experienced in 'selfing' them and obtaining fully developed bolls; nor was any deterioration in vigour or fertility noticeable in the progeny even after they had been self-fertilized for a number of years.

As soon as the bolls commenced to open, the plants of each type were examined to eliminate, if present, any accidental admixture of strains or 'rouges'. After this had been done, a few healthy plants which were fruiting well, were selected and labelled. The seed-cotton from each selected plant was carefully kept in a separate bag and afterwards critically examined in the laboratory to ascertain whether its seed-cotton, lint and seed characters were up to the required standard. This procedure was followed each year until this season when, owing to the length of time and labour required to make a detailed investigation of the numerous small lots of seed-cotton, it was decided to modify the practice somewhat. The quicker method now adopted is to examine and test the lint of each selected plant in a strain as hitherto, and then, if satisfactory, mix together, thoroughly, the seed-cotton from all the selected plants of that strain and take a representative sample from the bulk to obtain other data. As there was no cotton industry locally, this revised method was thought sufficient for present requirements, although not as reliable as the former in showing variations within a strain.

CHARACTERS OF LINT AND SEED OF SELECTED COTTONS, 1928.

Variety or Strain.	Mean maximum lint length in M.M. (1)	Lint Index (100 seeds) (2)	Average weight of seed in grms.	Weight of seed-cotton in grammes (100 seeds)	% Lint to seed-cotton (100 seeds.)	Remarks.
(1) Egyptian 'Assili'	31	6.79	.1305	19.840	34.22	Lint brown. Rather better than original selections.
(2) do 'Sakel'	40	5.19	.1326	18.450	28.12	Lint fine and long with slight brownish tinge.
(16) do do	39	5.51	.1447	19.980	27.55	do. do. do.
(5) Sea Island A. N.	48	5.84	.1489	20.730	28.19	Lint % rather low. Good ordinary long-staple Sea Island. Lint longer than original type.
(6) do U.S.S.	45	5.25	.1120	16.450	31.91	Lint rather short for Sea Island. Lint % high.
(24) Upland 'Acala'	34	7.47	.1435	22.020	33.92	Good long staple Upland.

(1) 25 Millimetres = 1 inch (approx.)

(2) Lint Index = the lint obtained from 100 seeds expressed in grammes.

- No. 1 is a selected strain of the well-known Egyptian 'Assili' cotton. Its lint is brown, short, even and strong. The lint-index and ginning percentage are high. The bolls are small, but open widely rendering picking easy and rapid. It sells readily.
- Nos. 2 & 16. are selected strains of the long-staple 'Sakel-
laridis' cotton which is grown so extensively in Lower Egypt and for which there is usually a large demand at good prices. The lint is fine and strong with a slight brownish tinge.
- Nos. 5 & 6. are selected strains of West Indian ordinary Sea Island cotton. The lint is white, long, fine and strong, but at the present time the demand for it is limited. It realizes the highest market prices when saleable.
- No. 24. is a good type of long-staple Upland cotton received under the name 'Acala' from Nanking, China. Its lint is white, fairly fine, even and strong and its lint index and ginning percentage are high. It would sell readily in quantity in most markets. Its seed is covered with fuzz, so that the seed-cotton would have to be saw-ginned to separate the lint from the seed, whereas the Sea Island and Egyptian varieties described above, are clean-seeded and would be roller-ginned.

VALUATION OF COTTONS.

The Liverpool prices in December, 1928, for the cottons of the classes described above were—

West Indian Ordinary Sea Island	23 ^d -27 ^d per lb.
'Sakel' Egyptian	19 ¹ / ₂ „

With middling Upland at 10¹/₂ pence per lb., the 'Assili' and 'Acala' cottons would probably be worth not less than 1/- per lb.

Hand-ginned samples were sent to cotton merchants in Shanghai for valuation, and the following report of Messrs. J. Spunt & Co., dated October 10th, 1928, is of interest.

No. 5.	Sea Island	—	17 $\frac{1}{4}$ ^d	per lb.	c.i.f.	Shanghai.
„ 6.	do.	—	18 $\frac{1}{2}$ ^d	do.	do.	do.
„ 1.	Egyptian 'Assili'	—	10 ^d	do.	do.	do.
„ 2.	„ 'Sakel'	—	14 $\frac{3}{4}$ ^d	do.	do.	do.
„ 24.	Upland 'Acala'	—	10 ^d	do.	do.	do.

Messrs. Spunt state that "types No. 1, 2 and 24 would be suitable for the Shanghai Market as the mills in China are not organized at the present time to spin very fine counts". In this connection it may be mentioned that No. 16. 'Sakel', which closely resembles No. 2. 'Sakel', would be worth 14 $\frac{1}{2}$ pence on the above valuations.

Whilst most attention has been given to Sea Island, Egyptian and Upland cottons yet, as mentioned above, other species and varieties have been examined. The results of the examination were as under.

LINT AND SEED CHARACTERS OF CERTAIN OTHER COTTONS GROWN LOCALLY.

No.	Species or Variety.	Mean maximum lint length in M. M. (20 seeds.)	Lint Index. (100 seeds.)	Average weight of seed in grms.	Weight of seed-cotton (100 seeds in grammes.)	% Lint to seed-cotton. (100 seeds).	Remarks.
12	Garó Hill	...	2.95	.0600	8.950	32.96	Very short, coarse lint. Seeds densely covered with fuzz.
11	Kidney or Chain	...	6.46	.1474	21.200	32.81	Short coarse lint. Seeds clean but cemented together.
19	Cambodia	..	5.84	.1250	18.340	30.99	Resembles an American Upland variety. Lint fair. Seeds covered with fuzz.
18	Uppam or Tinnevelly		2.20	.0590	8.120	27.09	Lint fairly fine. Lint index low. Seed small and fuzzy.
14	Grik	...	4.60	.0755	12.150	37.86	Lint long and fairly fine. Lint % high. Seeds clean with a tuft of brown fuzz.

Garo Hill Cotton. (*Gossypium arboreum* var. *assamica*, Watt). In the Garo hills the people make a peculiar kind of blanket from this cotton. It is of little commercial value, except to mix with wool, as the lint is coarse and short.

Kudney or Chain Cotton. (*Gossypium brasiliense*, Macf.). is the perennial tree-cotton found throughout Malaya in gardens. The lint is rough and coarse and of lower value than American middling Upland. It is occasionally spun into yarn for weaving purposes locally, and is also used as cotton-wool for dressings. Watt in his account of the early cultivation of this cotton states that "for many years past Brazilian or Kidney Cotton has taken a very subordinate position to Upland and Sea Island cotton and does not seem likely to recover ever again its lost popularity".

Cambodia Cotton. This cotton was obtained from Kuala Kangsar under this name. It was said to have been grown from imported seed. In lint and seed characters it resembled a long-staple Upland and was most likely a hybrid form of *Gossypium hirsutum*, Linn. and another species. Its lint was, however, inferior to standard long-staple Upland.

Uppum or Tannervelly. (*Gossypium obtusifolium* var. *Wightiana*, Watt). This is a well known Southern India long-staple cotton. The lint is fairly fine and long. The seed is very small and covered with fuzz. It is not as good as long-staple Upland. It grew very poorly in the local trials.

Grik Cotton. This name was applied to a cotton grown by the District Officer, Grik, Perak, in 1922. It was the best of the cottons found locally. It resembled the long-staple clean-seeded 'Marie Galante' cotton of the West Indies. Its origin was not definitely traced, but was supposed to have been brought from the Garo Hills some years previously. The flowers were of 3 types in respect to petal colour—

- (a) Yellow, no blotch
- (b) Cream, no blotch
- (c) Yellow with dark red blotch.

The seed was clean and free. The style much exceeded the stamens. The lint was fine and long and ginning percentage high. It was almost equal to long-staple Egyptian in quality.

The photograph, Plate (1), depicts a combed seed of each of the cottons named and described so that they can be compared with each other.

In the absence of large field trials under suitable soil and climatic conditions, it is difficult to give a reliable estimate of the yields likely to be obtained with selected varieties; still there appears to be no reason why 200 to 250 lbs. of lint per acre should not be obtained in average seasons.

The chief pests that have caused some damage to the plants in certain seasons were—

- (a) the larva of the moth, *Sylepta derogata*. F. which eats the leaves and rolls itself in them.
- (b) the larva of the small moth, *Earias fabia*. Stoll. which bores into, and destroys, young shoots and also bores into the immature bolls and feeds on the contents of them.
- (c) the cotton-stainer, *Dysdercus cingulatus*. F. which feeds on the seed in unopen and open bolls. The staining of the lint is due to micro-organisms which follow this sucking insect's attacks on the young boll.

Several other pests have been noticed causing minor damage, but the ones named above were those which were usually present. The pink-boll worm, *Platyedra gossypiella*, Saund, which is a major pest in many cotton-growing countries is said to occur locally, but has not yet been observed.

The control of insects such as the above-named is of prime importance in cotton-growing, and, unless effective methods are adopted to destroy and keep the pests in check, the industry is not likely to succeed.

SUMMARY.

- (a) A short account is given of trials made with Sea Island, Egyptian, Upland and other cottons in Malaya.

- (b) It is stated that trials generally have not been encouraging due chiefly to unsuitable soil, lack of knowledge of the crop and methods of controlling pests as well as to the difficulty of ginning and marketing small quantities of lint and seed.
- (c) More favourable soil and climatic conditions for cotton-growing are believed to exist in the Northern and Eastern States of the Peninsula than elsewhere, but expert advice and assistance should be made available to growers there if it is desired to establish the industry along the right lines.
- (d) It is mentioned that certain selected self-fertilized strains of Sea Island, Egyptian and Upland cottons have been grown experimentally for the past seven seasons without any deterioration in the vigour of the plants or quality of lint.
- (e) The characters of the seed-cotton, lint and seed of selected strains are given, together with market valuations of the lint they produce. Notes are included on the characters of certain other cottons grown locally.
- (f) The chief pests so far observed attacking the plants and bolls are mentioned.

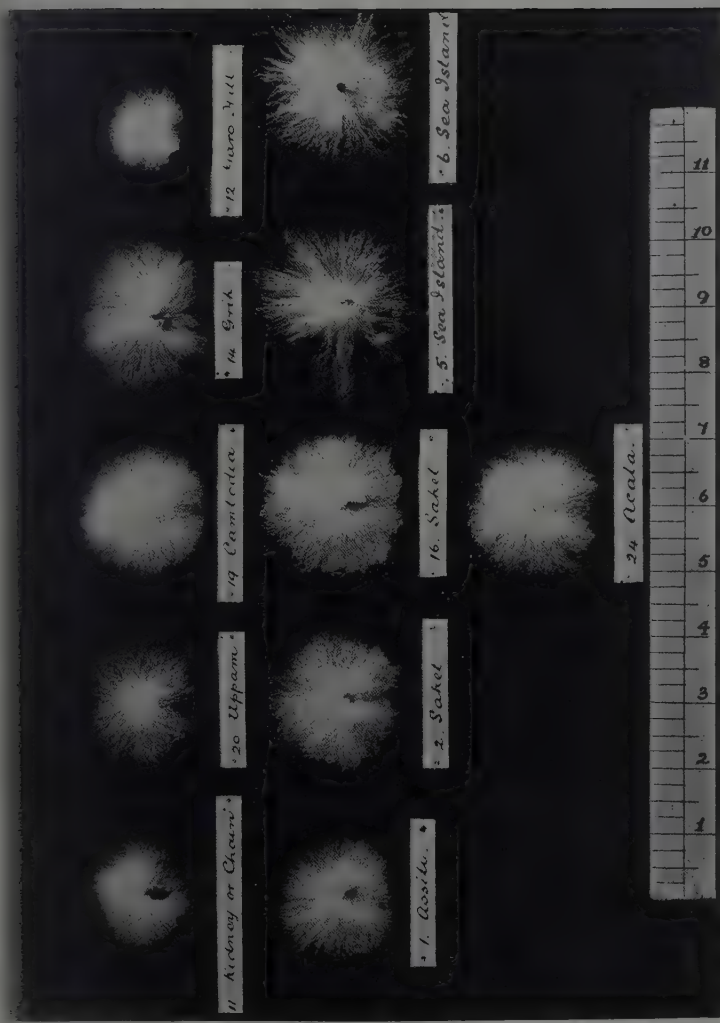


FIG. 1. UPPER SERIES.—Seed-cotton of varieties collected locally.
 LOWER SERIES.—Seed-cotton of Selected Strains of Sea Island, Egyptian and Upland varieties.

Variation in Coconuts.

BY H. W. JACK.

This brief note is supplementary to an article on "Variation in Coconuts" which was published in M.A.J. Vol. XV. No. 11, 1927 and which showed the frequency table of variation in fruit production of coconut palms over a period of seven years. The present note merely brings that table up to date for a total period of eight years, and further emphasises the conclusions already reached regarding variability in fruit production with this crop.

Those conclusions may be cited once more for convenience as a summary, but reference to the previous article above mentioned is invited.

The writer again expresses the gratitude of the Department of Agriculture towards the Staff of Jugra Lands and Carey Ltd. for their continued facilities in the maintenance of the records on which this note is based.

SUMMARY.

1. The coefficient of variability of fruit production of an average population of coconut palms is 34% of the mean production.

2. The variability in cropping per palm per annum ranges from 5 to 115 fruits on the block under observation containing 471 palms growing under apparently uniform conditions.

3. 19% of the palms on an average coconut plantation are not profitable.

4. $15\frac{1}{2}\%$ of the palms on an average plantation produce $24\frac{1}{2}\%$ of the total crop.

5. Poor yielding palms remain poor yielders, and high yielders are constantly high yielders.

TABLE.

This table shows the group frequencies of the average production of fruits per palm per annum over a continuous period of eight years.

Groups.	F.	F x G.	d.	d ²	Fd ²
5	1	5	54	2916	2916
15	11	165	44	1936	21296
25	34	850	34	1156	39304
35	44	1540	24	576	25344
45	65	2925	14	196	12740
55	88	4840	4	16	1408
65	83	5395	6	36	2988
75	71	5325	16	256	18176
85	35	2975	26	676	23660
95	32	3040	36	1296	41472
105	5	525	46	2116	10580
115	2	230	56	3136	6272
N = 471		F x G = 27815		ΣFd ² = 186156	

$$\text{Mean} = \frac{\Sigma F \times G}{N} = \frac{27815}{471} = 59.09, \text{ say } 59.$$

$$\text{Standard Deviation} = \sqrt{\frac{\Sigma F \cdot d^2}{N}} = \sqrt{\frac{186156}{471}} = \sqrt{395.24} = 19.88$$

$$\text{Coefficient of variability} = \frac{\text{S.D.} \times 100}{M} = \frac{19.88 \times 100}{59} = 33.6949 \text{ say } 34 \%$$

Marketing Rubber Seed.

D. H. GRIST.

PREVIOUS INVESTIGATIONS.

The value of the oil contained in rubber seed has been appreciated for many years. The Bulletin of the Imperial Institute Vol. XI No. 4, 1913, contains the results of the investigations of rubber seed oil; and the Agricultural Bulletin of the F.M.S. Vol. VI No. 5, 1918, contains an article on "The oil content, keeping qualities and commercial possibilities of para rubber seed". While it is not the purport of the present article to deal with this side of the question, it may be of interest to state briefly the potential value of this by-product of the rubber industry.

Rubber seed consists of approximately 37 per cent of shell, and 63 per cent of kernel. The oil content of the kernel is about 50 per cent, while that of the whole seed is about 25 per cent.

Certain correspondents have enquired regarding the manurial value of rubber seed. As far as the writer is aware, no work has been carried out on this subject. The following analyses were published by the Department of Agriculture in 1918.

Total ash on husks	0.70 per cent.
„ kernels	1.83 per cent.

Ash Analysis.

		Husk	Kernels
Percentage	Potash (K_2O)	38.6	37.2
„	Phosphates (P_2O_5)	16.8	28.6

The nitrogen content on dry shells is 0.22 per cent, and of dry kernels 2.45 per cent.

The above figures are based on samples of sound clean seed. Seed collected for export for the extraction of oil does not reach this high standard, as it contains a proportion of empty seed, and seed in bad condition.

One firm reports as a result of their experience in handling several thousands of tons, that they obtain,—kernels 46 per cent, shells 42 per cent, loss of weight 12 per cent on the weight as shipped. They further state that on a commercial scale the yield of oil from the kernels is 45 per cent, and from the whole seed 19 per cent.

The conclusions of the Imperial Institute were as follows:—

“Though para rubber seed oil is a drying oil it dries less quickly than linseed oil, and is therefore inferior to this oil for those industrial uses to which linseed oil is particularly suited. When linseed oil is high in price, however, it has to be replaced by oils that are intrinsically inferior to it for these purposes, and in such cases Para Rubber seed oil would be a valuable substitute. The defects of Para Rubber seed oil from this particular point of view are, however, advantages for other industrial purposes, since they enable it to be used to some extent in industries in which the employment of linseed oil is inadmissible. On the whole, the results of these trials clearly indicate that there would be no difficulty in finding a market for Para Rubber seed oil, provided it can be put on the market at a suitable price and in large quantities. In this connection mention may also be made of the fact that the new process of “hardening” liquid oils by hydrogenation if successful on a commercial scale, will open an entirely new market to oils of the Para Rubber seed type”.

The Department of Agriculture in 1916 consigned 30 tons of the seed to Hull for crushing and valuation; £50 per ton was obtained for the oil and the residual cake realised £8 per ton. At the time, linseed oil stood at £60 per ton.

The difficulties in these earlier attempts of marketing Para Rubber seed were many, including that of obtaining adequate shipping facilities, scarcity of labour, and lack of organisation.

An attempt was made to prepare the oil locally with a plant erected for the purpose. This venture proved unsuccessful.

REVIVAL OF INDUSTRY.

The question of deriving profit from the rubber seed produced in Malaya has recently received renewed attention owing to the offer of an American Corporation to purchase the seed. Briefly, the offer was to purchase such seed at \$22* per ton f.o.r., sacks to be provided by the Corporation. The seed collected is exported to Belawan, where it is decorticated, the kernels are dried, chemically treated to kill enzymes, bagged and shipped to America where the oil is extracted. The export of rubber seed from Malaya for 1928, as shewn in the returns of the Registrar of Imports and Exports, amounted to 7,905 tons, valued at \$246,940. Correspondence in the Press shewed that there was a divergence of opinion amongst planters as to whether rubber seed could be marketed profitably at this price. In view of the importance of the subject, this Department has undertaken an independent investigation, with the concurrence of the Rubber Research Institute. The conclusions which follow are compiled from a study of the facts supplied by the managers of thirty-six estates who have been engaged in the collection and export of rubber seed during the seed season 1928. The writer takes this opportunity of thanking these estates for the assistance they have rendered in this enquiry.

YIELDS OF RUBBER SEED.

Messrs. Spring and Day in 1918 collected seed from four estates (age not mentioned) which gave an average of 330 lbs. of seed per acre. They estimated the yield at 300 lbs. per acre, but pointed out that there was a seasonal variation to be taken into account.

Mr. Gotwaite of the Proscio Oils Corporation estimates the highest yield at 250 lbs. per acre, and the lowest at 100 lbs. per acre, from which he deduces an average of one ton of seed per 10 acres.

Returns of the rate of seed collected per acre were received from 10 estates; excluding one return, the average was one ton to 18 acres. It is to be noted that the season was generally considered one of little seed production.

* Straits Settlements Currency \$1/- two shillings and four pence.

The question of rate of payment for collection must also be taken into account. If the rate is too low when seed is scarce, the full amount will not be collected. It is as well therefore to regulate price for seed according to the ease of collection, i.e. by raising the price as the quantity collected decreases. As an instance of this system, may be quoted the following from one estate:—

“At first I paid at the rate of 6 cents per kerosine tin and 26 tons were collected at this rate. Later I increased the rate to 7 cents per kerosine tin and got a further 20 tons. Again I had to increase the rate to 8 cents per tin which resulted in a further 7 tons”.

The cost of collection in this instance averaged \$8.27 per ton. It is probable, therefore, that the average of one ton to 18 acres does not represent the maximum obtainable, but is governed by the amount that it was profitable to collect.

The amount of seed that is produced in the country, based on one ton to 10 acres and $2\frac{1}{4}$ million acres of rubber is 225,000 tons, but it is impracticable to collect the total amount produced. Land cultivated with a cover crop may be ruled out, while transport costs may be prohibitive in some districts. In addition, collection on hilly land seems less attractive to collectors; and in other instances, alternative and more profitable forms of spare time labour prove serious competitors to rubber seed collection. It is probable, however, that about 100,000 tons per annum of rubber seed could be economically marketed, which at the present price is worth \$2,000,000.

COLLECTION.

Cost of collection is the largest item in marketing rubber seed. It is noticeable that on the large majority of estates Indian labourers are used for this purpose, although instances occur where Malays, Javanese and Chinese have been successfully employed. The average amount paid for the task is 5 cents per kerosine tin, or half a cent per kati. The actual amount offered for collection has varied somewhat according to the main object of the manager concerned. In some cases the marketing of rubber seed is looked upon merely as a commercial proposition, in which case the cost of collection is kept at a minimum; in other cases, it is treated as a spare time occupation and the rates are raised so that the labourers

can take a share of the profits, while on one estate the profit derived was used solely for the benefit of the coolies by being given to the estate Temple Fund. Figures of the cost of collection obtained from twenty-eight estates average \$9.30 per ton, with a range from \$6.00 to \$14.00 per ton.

It is generally considered advisable either to pay cash for daily delivery or make a weekly payment; this system seems to apply to all estates from which favourable replies have been received.

PACKING, WEIGHING, LABELS, TWINE.

The average cost of these operations on the twenty-five estates that give figures shews a wide variation, from the lowest—8 cents per ton—to the highest—\$2.89 per ton. It is probable that the higher figures include other charges peculiar to the estate concerned. The average cost, however, on 25 estates, is 87 cents per ton.

SUPERVISION.

There was a divergence of opinion as to whether, if no extra supervision charges were incurred, any cost of marketing should be debited under this head. It is correct to charge a certain amount to supervision for this work and to reduce the amount under this head in the cost of rubber production. Nine estates only included supervision under the charges of rubber seed production—the average cost being 88 cents per ton.

From the experience of the past season, it is evident that closer supervision is essential. Consignments of seed have been held up at port because they were in such a condition that they could not be certified as being free from pests and diseases. The lack of supervision was evident by the presence of a large proportion of empty and dirty shells, old and mouldy seeds, the introduction of quantities of foreign matter in the shape of earth, leaves and twigs of rubber, while in many cases seed was packed in wet bags, and being necessarily consigned in closed railway trucks, very considerable heat was generated, resulting in active germination of sound seed *en route*. These difficulties would be obviated if managers instituted some control over the condition, packing and despatch of collections.

In this connection it should be explained that no regulations governing the export of plants or parts of plants in general and of rubber seed in particular are imposed by the local Government. Most countries, however, have brought into force Rules governing the importation from foreign countries of living plants, parts of plants and seeds, in order to reduce the danger of introduction of pests and diseases not previously existing in the importing country. Almost all such rules require that consignments of plants and seeds shall be accompanied by a certificate of freedom from pests and diseases signed by a properly qualified officer in the exporting country. Such a certificate is required by the Government of the Netherlands East Indies to accompany each consignment of rubber seed. It has been arranged that before granting such a certificate ten out of each 100 bags of seed shipped will be inspected by an officer of the Department of Agriculture at the Malayan Port from which the seed is being despatched. If the rubber seed is found to be covered with earth, which may itself convey infection, or to consist of a high percentage of old partly empty shells with shrunken and mouldy contents, it is obvious that the required certificate cannot be signed in good faith. If the consignment cannot be granted a certificate it will be refused entry into Belawan and it is, in consequence, useless to despatch it. If part of a mixed consignment is in a bad condition that portion must be removed before the required certificate for the remainder can be signed.

TRANSPORT.

The amount spent on transport naturally shewed great variation. The average cost of all operations other than transport is approximately \$11 per ton. With the selling price at \$22, the sum of \$11 remains from which transport and profits are to be found. It remains therefore a case for individual consideration as to whether the estate is so situated as to make a profit possible. Twenty six estates gave their figures for transport, the lowest was 26 cents per ton, while the highest was \$7.50 per ton. All of these estates marketed their seed at a profit. The estate with the lowest transport cost made a profit of 123 per cent, while the estate with the highest transport cost (but lower cost of collection) made a profit of 47 per cent. The average transport expenses of twenty three estates was \$2.61 per ton.

TOTAL COSTS.

The average costs, so far as figures are available, for the collection and marketing of Para rubber seed are as follows:—

Collection	...	\$9.30	(28 estates)
Packing etc.	...	.87	(25 „)
Supervision	...	.88	(9 „)
Transport	...	2.61	(26 „)
		\$13.66	

Therefore the average profit amounted to 67 per cent. The estate with the highest profit made 160 per cent, while only three estates reported a loss, due to conditions peculiar to the estates in question.

VALUE OF THE INDUSTRY.

It has been proved that if the seed can be collected at from 5 to 8 cents per kerosine tin, a profit can be made depending upon the distance of the estate from the railway station.

Taking the above figures as a basis, the value of rubber seed amounts to fifty cents per acre per annum. To this, as has been pointed out by many correspondents, may be added a small amount which represents the amount saved on weeding costs. This is estimated at from 15 to 20 cents per acre per annum.

The benefits of this industry cannot be judged by the profit and loss account alone. Eighty per cent of the estate managers who have written on this subject point out that the scheme is of assistance in keeping a contented labour force, providing work for women and children (generally a problem on an estate with Indian labour), and thus being of especial assistance to labourers with large families.

CONCLUSIONS.

The marketing of rubber seed, at present prices, is profitable providing that transport is not prohibitive, the estate

has a settled labour force, is clean weeded, and not too steep; and that there are not more remunerative forms of spare time employment for the coolies.

The average cost of production allows a profit of over 50 per cent to the estate.

The work is popular amongst labourers and their families, who are thus able to add considerably to their wages.

Planters have gained valuable experience during the past season in maketing rubber seed, and it is anticipated that improved returns will result in future seasons from a closer supervision of the collections.

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Preliminary Report on the Cultivation of *Aleurites Montana*.

J. N. MILSUM AND T. D. MARSH.

A small area of land at the Government Plantation, Serdang, was planted with seedlings of *Aleurites montana*, Wils., a Chinese Wood Oil Tree, early in 1925. The object of this paper is to record the growth and behaviour of these trees up to the end of the year 1928.

A description of the tree has already been published in this Journal (Vol. XII, January, 1924, No. 1, p. 1. "Candle-nut and Chinese Wood Oil Trees").

In a subsequent paper (M.A.J., Vol. XVI, August, 1928, No. 8, p. 296) a report, prepared by the Chemical Division of the Department, was published on the oil content of seeds harvested at Serdang, together with the analytical constants of the oil.

SOURCE OF SEED.

The seed was obtained from the Botanical and Forestry Department, Hong Kong. One consignment weighing 4 lbs. 4 ozs. and containing 750 seeds, was received in December, 1923 and another weighing 4 lbs. 10 ozs. and containing 735 seeds, was received during November, 1924.

GERMINATION OF SEED.

The first consignment of seeds was sown in seed-boxes, containing prepared soil, on the 8th December, 1923. Germination commenced six weeks later and continued for a period of nearly three months. The seeds, however, were not in good condition and only 15 per cent. germination was obtained. The young seedlings were lifted from the seed boxes and planted in small bamboo baskets and kept under shade. As there was insufficient stock for planting the area set aside for this tree, the young plants were subsequently transplanted into pots and retained until the plants raised from the second consignment were large enough to plant out in the field.

The second consignment of seeds was sown in boxes on the 18th November, 1924. Germination commenced a month after sowing the seeds and continued for nearly two months. In this instance the seeds were evidently in better condition as 45 per cent. germination was recorded. The seedlings were planted in bamboo baskets when large enough to transplant from the seed boxes.

PLANTING IN THE FIELD.

The land allotted to this crop comprised an area of $3\frac{1}{2}$ acres, situated at the base of a somewhat steep hill in the centre of the plantation. The soil may be described as a heavy laterite loam.

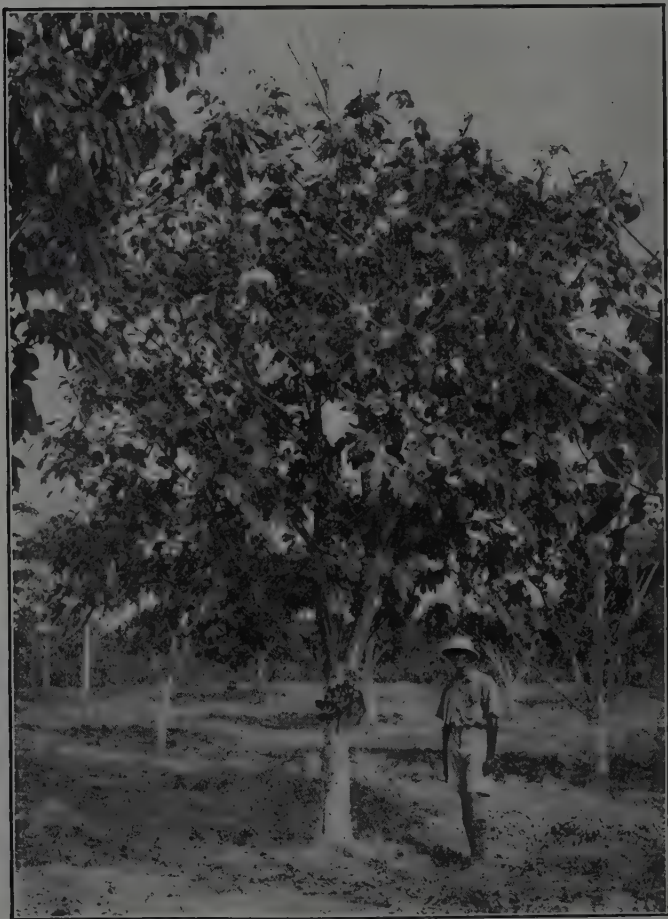
The area was lined and holed at a distance of 20 feet by 20 feet square planting, allowing 108 trees to an acre. Large-sized holes were dug, and in view of the fact that the land had been under cultivation for several years and consequently had suffered to some extent from erosion, a basket of cattle-manure was added to each hole.

Plants raised from both consignments of seeds were planted out during March, 1925. A number failed to become established and during the ensuing planting season (November, 1925) it was necessary to replant 20 per cent. of the holes.

A cover crop, *Calapogonium mucunoides*, was then established over the area, but did not prove a complete success owing to the land having been opened for some considerable time.

GROWTH AND HABIT OF THE TREES.

After planting growth was rapid, especially in the case of the trees planted on the lower part of the area. One tree flowered in March, 1926 and a few mature fruits were collected in April, 1927, i.e., two years after planting in the field. A number of trees flowered during 1927 and a few pounds of seeds were collected during that year. Early in 1928 more trees flowered and in the following June about 35 lbs. of dried seeds were harvested from five of the largest trees. In August, 1928 a number of trees were flowering freely and at the close of the year the majority of trees had



Aleurites Montana, four years old, at the
Experimental Plantation, Serdang.

reached the flowering stage and a number of trees were bearing fruit. One such tree was observed to be bearing about 100 fruits.

Flowering and fruiting occurs throughout the year, but flowering is heaviest during the dry seasons of the year, i.e., January/February and July/August.

Great variability exists in the shape of the leaf of the trees. Certain trees have almost all cordate leaves, while others are palmately five-lobed. Shoots from the trunk usually have palmate leaves.

The flowers are glistening white when they first open, but later show a deep pink centre. The individual flowers are 2.25 inches in diameter and produced in large terminal racemes on the shoots of the previous season's growth.

After flowering, the stem of the female inflorescence becomes woody in order to support the fruit.

The fruits turn black as they mature on the trees and fall to the ground. The husk of the fruit then splits open from the base upwards and the seeds are readily extracted. About 160 seeds, after sun-drying, weigh one pound, which is approximately the same weight as the seeds originally received from Hong Kong.

Usually only three to four fruits mature on a single raceme, but recently a greater number have been noticed, totalling fifteen in some cases.

The fruit generally contains three seeds, but specimens containing four seeds are often obtained.

The average height of the trees at the close of the year 1928 was 15 feet, though a number of specimens exceeded 20 feet. The average spread, i.e., the distance from the trunk to the outermost branches was 7 feet. The circumference, at 2 feet from the ground, averaged 16 inches. A number of the largest trees, however, exceeded 24 inches, (see Plate I).

Aleurites montana is stated to be indigenous to South Eastern China, being found in the Province of Fokien southward to Tongking (see *Kew Bulletin*, 1914, p.1. "The Wood-oil Trees of China and Japan"). It would appear, therefore,

that the climate of the Malay Peninsula, with its continuous high temperature, would be unsuitable for complete success with this species. The growth of the trees at the Government Plantation, Serdang, supports this supposition.

The behaviour of the individual trees is erratic and specimens are to be found flowering, fruiting, and wintering at the same time. It is thought that the lack of a definite cold season in Malaya causes this phenomenon. Generally speaking the trees appear to be unaccustomed to local climatic conditions. The trees have produced numerous lateral suckers during the whole period of their growth, which were removed periodically. It is possible that this species would show a more vigorous growth at high elevations in Malaya.

BUD-GRAFTING ON INDIGENOUS STOCK.

In view of the behaviour of the trees an attempt was made early in 1928 to bud scions of *Aleurites montana* on to stocks of the indigenous *A. triloba*, Forst., the candle-nut.

The method employed was a form of "patch budding". A total of sixty-five stocks were so budded and twenty-seven showed every signs of being successful. After the upper portion of the stock was cut back a growth of 1 to 2 inches took place and a number of the successfully budded plants were removed to the field. All these trees, however, as well as those remaining in the nursery, died during the subsequent dry season.

The stocks were rather old and it is thought that complete cutting back of the young trees after the buds had become united was too severe. It is intended to proceed further with experiments on these lines.

PESTS AND DISEASES.

After a complete stand was established no trees were lost from either pests or diseases. The trees, however, have been periodically attacked by a large Case worm (*Psychid* sp.) and on some occasions this pest has assumed serious proportions, but has been kept in check by hand-picking. So far no disease has been observed amongst the trees.

GENERAL REMARKS.

Although the trees under reference have made comparatively rapid growth and are now producing fruit, the indications are that this species of *Aleurites* is not altogether suited to the conditions prevailing on the plains in this country. It will, however, take some time to decide this point. In the meantime it is proposed to proceed further with the bud-grafting experiments.

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Baker Memorial Professorship.

The Board of Regents of the University of the Philippines has established a Baker Memorial Professorship in the College of Agriculture. This professorship is in memory of Charles Fuller Baker who was dean of the College of Agriculture from 1917 until his death in July, 1927.

This professorship provides for the services in the College of a man from abroad who shall be in residence in the College eight months at least and shall carry a teaching load of five hours a week. It is the purpose to secure men who are specialists in the different sciences allied to agriculture. This professorship in honoring Dean Baker provides for incalculable benefit to the College which in itself is a fitting tribute to a man whose services to the College were so valuable.